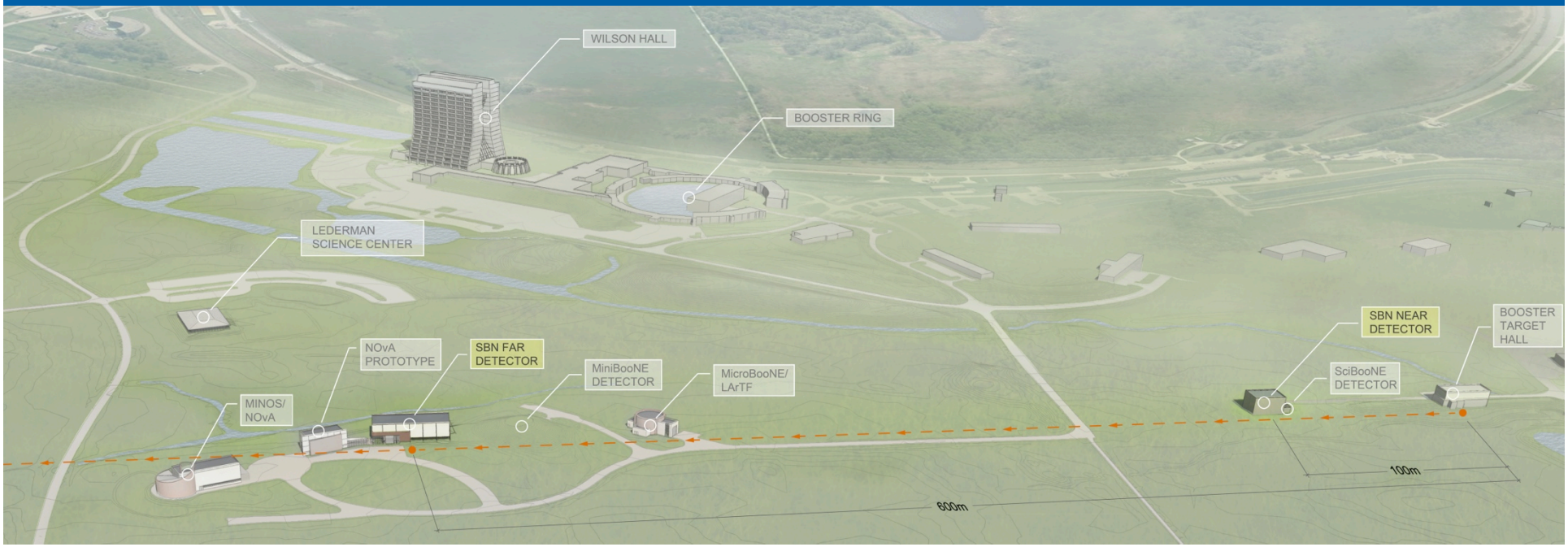

SBN @ Fermilab

Sam Zeller

SBN DOE/NSF Briefing

1-2 August 2016

Group Introduction

- Fermilab holds a unique role as the host lab to the SBN program
  - 23 scientists, 2 postdocs, and > 20 technical staff who are currently contributing to the program
  - Physics interests: neutrino oscillations, neutrino interactions, and proton decay backgrounds in LAr
  - Technology interests: project management, operations support, accelerator neutrino beams, computing resources, cryogenics, mechanical and electrical engineering, drift high voltage, light collection, online and offline systems, reconstruction, software tools
  - Relevant past achievements:
    - SBN Director's progress review in December 2015
    - Successful installation, commissioning, and operations of μB
- Current funding supporting contributions to SBN activities
  - Intensity Frontier Research: KA220102
  - Zeller Early Career award: KA1101022

  } scientific support

  - Intensity Facilities Operations: KA02022
  - Intensity Projects Future SBN: KA220302

  } technical support

Scientist Summary: Neutrino Beams

- **Byron Lundberg** (60% FTE), 45% SBN, 15% Shielding Assessment Committee
  - 20% BNB Improvements: performance, neutrino flux predictions and upgrades
  - 25% MicroBooNE: TPC noise filtering Editorial Board
- **Alberto Marchionni**, 30% SBN, 50% DUNE/LBNF, 20% LArIAT/NA61
  - 10% BNB Improvements: performance, neutrino flux predictions and upgrades
  - 20% MicroBooNE: Technical Board, NuMI event analysis, beam timing Editorial Board
- **Zarko Pavlovic**, 95% SBN, 5% DUNE
  - 10% SBND: neutrino beam simulations, FNAL IB Representative
  - 55% BNB Improvements: Lead from Neutrino Division
  - 30% MicroBooNE: Beam Group Co-Convener, BNB flux expert, runs weekly BNB operations meetings

Scientist Summary: Computing, Software, Reco

- **Bruce Baller**, 80% SBN, 20% LArIAT/protoDUNE
  - 10% SBND: reconstruction
  - 70% MicroBooNE: reconstruction, μB FNAL ND Group Leader, drift velocity and Pandora Editorial Boards
- **Herb Greenlee**, 90% SBN, 10% DUNE
  - 90% MicroBooNE: Analysis Tools Co-Convener, reconstruction, software tools
- **Wes Ketchum**, 80% SBN, 20% protoDUNE
  - 20% SBND: DAQ, event builder
  - 40% MicroBooNE: Analysis Tools Co-Convener, DAQ, trigger
  - 20% ICARUS: DAQ, event builder
- **Mike Kirby**, 60% SBN, 40% Associate Deputy Head Scientific Distributed Computing Solutions
  - 10% SBND: SBN online system task force
  - 50% MicroBooNE: Computing Liaison, computing model task force, Data/MC Production Co-Convener
- **Gianluca Petrillo**, 20% SBN, 80% LArSoft Lead Developer
  - 20% SBND: Computing Liaison
- **Erica Snider**, 50% SBN, 50% LArSoft Project Lead
  - 50% MicroBooNE: Reconstruction Group Co-Convener, short track reco for QE and oscillation physics
- **Panagiotis Spentzouris**, 20% SBN, 80% Scientific Computing Division Head
  - 20% MicroBooNE: uB FNAL SCD Group Leader, deep learning Editorial Board, reconstruction

Scientist Summary: SBND, MicroBooNE, ICARUS

- **Angela Fava**, 100% SBN
  - 100% ICARUS: TPC readout electronics and DAQ, timing and trigger systems
- **Fernanda Garcia**, 30% SBN, 70% accelerator (PIP, PIP-II)
  - 30% ICARUS: detector integration and installation
- **Stephen Pordes**, 30% SBN, 20% Darkside, 35% LAr R&D, 15% Other
  - 30% MicroBooNE: Rate Task Force Leader, detector stability Editorial Board
- **Jen Raaf**, 10% SBN, 60% ECRA, 10% DUNE, 20% LArIAT
  - 10% MicroBooNE: on-call TPC + drift HV expert, proton decay bkgs, nucleon decay Editorial Board
- **Anne Schukraft**, 100% SBN
  - 50% MicroBooNE: Cross Section Group Co-Convener, ν_μ CC analysis lead
  - 50% ICARUS: cosmic ray tagger
- **Thomas Strauss**, 10% SBN, 90% Technical Division magnet systems
  - 10% MicroBooNE: Shift Scheduler
- **Matt Toups**, 75% SBN, 15% DUNE/protoDUNE, 10% LAr R&D
  - 15% SBND: light collection
  - 60% MicroBooNE: Physics Co-Coordinator
- **Tingjun Yang**, 50% SBN, 40% DUNE, 10% LAr R&D
  - 50% MicroBooNE: reconstruction, detector physics & calibrations, ν_μ CC analysis

Scientist Summary: SBN Program Coordination & Collaboration Leadership

- **Cat James**, 100% SBN
  - 90% SBN: Deputy SBN Program Coordinator, Infrastructure & Installation Technical Coordinator
  - 10% MicroBooNE: on-call drift HV expert, data/Monte Carlo comparison Editorial Board
- **Ting Miao**, 100% SBN
  - 100% SBND: Technical Coordinator
- **Ornella Palamara**, 90% SBN, 10% ArgoNeuT
  - 80% SBND: Co-Spokesperson, SBN analysis task force
  - 10% MicroBooNE: reconstruction expert, proton multiplicities in ν_μ CC interactions
- **Peter Wilson**, 100% SBN
  - 100% SBN: SBN Program Coordinator
- **Sam Zeller**, 80% SBN, 20% FNAL Neutrino Physics Department Head
  - 80% MicroBooNE: Co-Spokesperson, neutrino interaction expert

Postdoc Summary

- **Raquel Castillo Fernandez**: 100% on SBN, started on SBN in 2015
  - 50% SBND: TPC electronics, test stand software
  - 50% MicroBooNE: systematics for ν_μ CC analysis, Overburden Group Co-Convener
  - NuMI neutrinos in MicroBooNE
  - Calculated systematics for ν_μ CC analysis on MicroBooNE, put together cost estimate and plans for possible addition of overburden on the MicroBooNE detector hall

- **Kanika Sachdev**: 10% on SBN, started on SBN in 2016
  - 10% SBND: light detection,
  - Set up production line at FNAL for producing light guide bars, constructed test stand for light guide quality control, improved light guide performance (*arXiv:1604.03103*)

- We had 3 SBN postdocs recently advance (**Carls, Lockwitz, Schukraft**). Plan is to hire 1-2 new postdocs in ND (job ad is out now) + 1 new postdoc in SCD in FY17.

Former SBN Postdocs

- **Ben Carls**: 100% SBN, left for private sector in 2016
  - 100% MicroBooNE: Detector Physics Co-Convener, purity monitor expert, reconstruction developer (fuzzy clustering), head of Monte Carlo production for μB (2012-2014), LAPD, μB virtual reality platform
  - Convened group producing first detector physics results from MicroBooNE, system lead for MicroBooNE purity monitors

- **Sarah Lockwitz**: 20% SBN, hired as AP protoDUNE in 2016
  - 20% MicroBooNE: drift high voltage, cosmic ray reconstruction
  - Designed, built, installed drift high voltage feed-through for μB, system lead for μB high voltage, expert on high voltage breakdown in liquid argon supported by LDRD grant (*arXiv:1506.04185*, *arXiv:1408.0264*)

- **Anne Schukraft**: 100% SBN, hired as AS on SBN in 2016
  - 100% MicroBooNE: Neutrino Cross Section Group Co-Convener
  - Lead the team that produced first ν_μ CC measurements from μB, first neutrino identification in μB, floor manager during μB installation, lead μB detector cabling, designed and deployed camera to look inside μB vessel (*arXiv:1507.02508*), contributor to ν cross section review in PDG, supported through Zeller's ECRA

Key Technical Staff

- Engineer/Technicians:
  - **Bill Badgett**, computing services specialist, 75% SBN, DAQ test stand, DAQ and online
  - **Michael Backfish**, external beams engineering physicist, 20% SBN, Booster neutrino beam
  - **Linda Bagby**, electrical engineer, 50% SBN, SBN Electrical Coordinator, detector integration + electronics installation
  - **Mike Delaney**, drafter, 50% SBN, cryogenics design
  - **Mike Dinnon**, project manager, 70% SBN, Logistics Coordinator, cryogenics engineering management
  - **Roza Doubnik**, mechanical engineer, 50% SBN, cryogenics design
  - **Michael Geynisman**, mechanical engineer, 80% SBN, cryogenics design, on-call for MicroBooNE cryogenics support
  - **Steve Hentschel**, designer, 50% SBN, detector integration design
  - **Dave Huffman**, electrical engineer, 10% SBN, electronics installation
  - **Bryan Johnson**, ND technician, 60% SBN
  - **Jim Kilmer**, mechanical engineer, 5% SBN, detector integration design
  - **Tom Kobilarcik**, external beams engineering physics, 20% SBN, Booster neutrino beam
  - **Min Jeong Kim**, engineering physicist, 75% SBN, SBND cryostat design and L2 manager
  - **Barry Norris**, electrical engineer, 50% SBN, cryogenic engineering management, project engineer, cryogenic controls
  - **Fritz Schwartz**, mechanical engineer, 50% SBN, cryogenics design
  - **Aria Soha**, 80% SBN, operations support
  - **Andy Stefanik**, mechanical engineer, 70% SBN, SBN Integration Engineer, detector integration design and management
  - **Justin Tillman**, designer, 100% SBN, detector integration design
  - **Donatella Toretta**, computing services specialist, 75% SBN, DAQ and online, operations support, μB run control
  - **Mike Zuckerbrot**, mechanical engineer, 50% SBN, cryogenics design, on-call for MicroBooNE cryogenics support
- Information Technology:
  - **Gennadiy Lukhanin** (lead), 1.0 FTE, online systems
  - **Bonnie King, Mike Kirby, Gene Oleynik** (leads), 5.5 FTE, computing and storage resources
  - **Mike Kirby** (lead), 4.0 FTE, frameworks and simulation
- Interviewing now for 2 add'l engineers on SBN. Plan to use PPD technician resources for both mechanical & electrical (process controls) work & hire 1-2 technicians in ND in FY17 (VetTech program).

SBN Activities

- Multiple major responsibilities in our role as host lab for the SBN program
  - SBN program coordination ***(Wilson, James)***
  - Technical coordination ***(Garcia, James, Miao, Pavlovic)***
  - Collaboration leadership ***(Palamara, Zeller)***
  - Cryogenics ***(Norris, Delaney, Dinnon, Doubnik, Geynisman, Kim, Schwartz, Zuckerbrot)***
  - Designers and drafters ***(Delaney, Hentschel, Tillman)***
  - Electrical and mechanical engineering ***(Bagby, Huffman, Kilmer, Stefanik)***
  - Technicians ***(PPD and ND)***
  - Operations ***(ELOs)***
  - Data acquisition and online systems ***(Badgett, Fava, Ketchum, Toretta)***
  - ESH&Q oversight ***(Aparicio)***
  - Common software tools: artDAQ, art/LArSoft, GENIE, GEANT ***(Amundson, lead)***
  - Common computing resources and tools: FIFE, GPGrid, OSG ***(Kirby, lead)***
  - BNB operations ***(Kobilarcik, Backfish)*** *&* upgrades ***(Pavlovic, Kobilarcik, Lundberg, Marchionni)***
- Played a major role in getting out first results from MicroBooNE
  - **Toups** as Physics Co-Coordinator, **Schukraft** as head of ν_μ CC analysis group, **Ketchum** & **Greenlee** as AT Co-Coordinators, **Snider** as Reco Co-Convener
- Provide support to & work closely with Univ groups and other labs on SBN

Scientists on SBN by FY

	FY16	FY17	FY18	FY19
Bruce Baller	70%	80%	80%	80%
Angela Fava	100%	100%	100%	100%
Fernanda Garcia	25%	30%	30%	25%
Herb Greenlee	85%	90%	90%	80%
Cat James	100%	100%	100%	100%
Wes Ketchum	80%	80%	80%	80%
Mike Kirby	60%	60%	50%	40%
Byron Lundberg	45%	45%	45%	45%
Alberto Marchionni	30%	30%	30%	30%
Ting Miao	100%	100%	100%	100%
Ornella Palamara	90%	90%	100%	100%
Zarko Pavlovic	95%	95%	90%	90%
Gianluca Petrillo	20%	20%	20%	20%
Stephen Pordes	10%	30%	0%	0%
Jen Raaf	20%	10%	10%	10%
Anne Schukraft	100%	100%	100%	100%
Erica Snider	50%	50%	50%	50%
Panagiotis Spentzouris	20%	20%	20%	20%
Thomas Strauss	10%	10%	20%	20%
Matt Toups	85%	75%	80%	80%
Peter Wilson	100%	100%	100%	100%
Tingjun Yang	50%	50%	50%	50%
Sam Zeller	80%	80%	80%	80%

Postdocs on SBN by FY

	FY16	FY17	FY18	FY19
Raquel Castillo Fernandez	100%	100%	100%	100%
Kanika Sachdev	10%	10%	30%	30%
Postdoc #3 (SCD)		100%	100%	100%
Postdoc #4 (ND)		100%	100%	100%
Postdoc #5 (ND)			100%	100%
Postdoc #6 (ND)			100%	100%
Postdoc #7 (ND)				100%
Postdoc #8 (ND)				100%

- Plan to hire 1-2 new postdocs each year on SBN

Key Technical Staff on SBN by FY

	FY16	FY17	FY18	FY19
Bill Badgett	35%	75%	60%	60%
Linda Bagby	45%	50%	50%	50%
Mike Delaney	60%	50%	25%	5%
Mike Dinnon	75%	70%	60%	20%
Rosa Doubnik	55%	50%	50%	25%
Michael Geynisman	90%	80%	75%	50%
Steve Hentschel	100%	50%	50%	10%
Min Jeong Kim	90%	75%	75%	50%
Barry Norris	70%	50%	50%	30%
Fritz Schwartz	30%	50%	50%	25%
Andy Stefanik	40%	70%	70%	50%
Justin Tillman	90%	100%	100%	50%
Donatella Toretta	10%	75%	60%	60%
Michael Zuckerbrot	35%	50%	50%	25%
new controls engineer		50%	50%	25%
new mechanical engineer		80%	80%	50%

Scientists on SBN by Location

	FY16	FY17	FY18	FY19
Bruce Baller	FNAL	FNAL	FNAL	FNAL
Angela Fava	CERN	50% CERN/50% FNAL	FNAL	FNAL
Fernanda Garcia	FNAL	FNAL	FNAL	FNAL
Herb Greenlee	FNAL	FNAL	FNAL	FNAL
Cat James	FNAL	FNAL	FNAL	FNAL
Wes Ketchum	50% BERN/50% CERN	CERN	FNAL	FNAL
Mike Kirby	FNAL	FNAL	FNAL	FNAL
Byron Lundberg	FNAL	FNAL	FNAL	FNAL
Alberto Marchionni	FNAL	FNAL	FNAL	FNAL
Ting Miao	FNAL	FNAL	FNAL	FNAL
Ornella Palamara	FNAL	FNAL	FNAL	FNAL
Zarko Pavlovic	FNAL	FNAL	FNAL	FNAL
Gianluca Petrillo	FNAL	FNAL	FNAL	FNAL
Stephen Pordes	FNAL	FNAL	FNAL	FNAL
Jen Raaf	FNAL	FNAL	FNAL	FNAL
Anne Schukraft	FNAL	FNAL	FNAL	FNAL
Erica Snider	FNAL	FNAL	FNAL	FNAL
Panagiotis Spentzouris	FNAL	FNAL	FNAL	FNAL
Thomas Strauss	FNAL	FNAL	FNAL	FNAL
Matt Toups	FNAL	FNAL	FNAL	FNAL
Peter Wilson	FNAL	FNAL	FNAL	FNAL
Tingjun Yang	FNAL	FNAL	FNAL	FNAL
Sam Zeller	FNAL	FNAL	FNAL	FNAL

Postdocs on SBN by Location

	FY16	FY17	FY18	FY19
Raquel Castillo Fernandez	FNAL	FNAL	FNAL	FNAL
Kanika Sachdev	FNAL	FNAL	FNAL	FNAL
Postdoc #3 (SCD)		FNAL	FNAL	FNAL
Postdoc #4 (ND)		FNAL	FNAL	FNAL
Postdoc #5 (ND)			FNAL	FNAL
Postdoc #6 (ND)			FNAL	FNAL
Postdoc #7 (ND)				FNAL
Postdoc #8 (ND)				FNAL

Key Technical Staff on SBN by Location

- All technical staff working on SBN currently based at Fermilab.
- **David Montanari** has been based at CERN since Jan 2015. Initially, he worked 50% on SBN but transitioned to 100% LBNF at the beginning of FY16. David continues to provide a liaison role for SBN at CERN.
- In early 2016, **Mike Zuckerbrot** was at CERN for ~6 weeks.
- We expect all engineers to be based at Fermilab in FY17 and beyond.

Conclusion

- Fermilab holds a unique role as the host lab to the SBN program
  - 23 scientists (Neutrino Division, Accelerator Division, Scientific Computing), 2 postdocs, > 20 technical staff who are currently contributing to the program
  - Our technical interests are in project management, operations support, neutrino beams, computing resources, cryogenics, mechanical and electrical engineering, drift high voltage, light collection, online and offline systems (common solutions), reconstruction, software tools
  - Our physics interests are in neutrino oscillations, neutrino interactions, and proton decay backgrounds in LAr
  - Our postdocs are working on neutrino interaction measurements in MicroBooNE and light collection in SBND, with plans to hire more PDs
- Achievements in 2016:
  - Major contributions to MicroBooNE commissioning, operations (cryogenics), computing, reconstruction, analysis, and leadership leading to first results at summer conferences
  - Construction of both new SBN buildings has started and is well toward completion
  - Cryogenics systems for ICARUS and SBND has progressed to final design in collaboration with CERN and INFN
  - ICARUS integration and installation plan is nearing completion
  - SBND preliminary integration design is completed